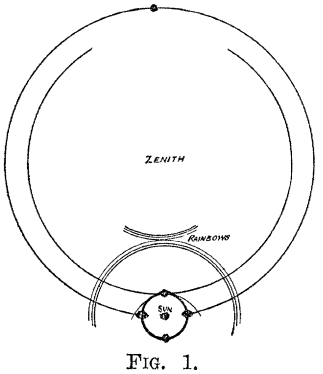

FIG. 1.

tinctly marked, and persisted for hours. The bright spot at the opposite pole from the sun was only occasionally visible. The rainbows were brilliantly colored and could be seen until the sun was almost down.

The sky at the time was almost clear, except for a few wisps of cloud and a thin haze which was densest directly over the face of the sun.

A. W. FREEMAN

SCIENTIFIC BOOKS

Photo-electricity. By H. STANLEY ALLEN. London, Longmans, Green and Co., 1913. 8vo. Pp. ix + 221. Price $2.10 net.

Photo-electricity. By ARTHUR LLEWELYN HUGHES. Cambridge, The University Press, 1914. 8vo. Pp. viii + 144.

The present generation of physicists has seen the rapid and almost spectacular development of several important fields of activity in physics: such, for example, as the subject of electric waves, of kathode rays and electrons, of X-rays, and of radioactivity. While the subject of photo-electricity has not aroused the same widespread and popular interest as the subjects just mentioned, there are at present many reasons for believing that the study of photo-electric phenomena may prove to be of almost equal importance in its bearing upon theories of atomic structure and of radiation.

I imagine that most physicists have read the paper in which Hertz described his discovery of the photo-electric effect. The paper is reprinted in Hertz's "Ausbreitung der elektrischen Kraft" and in the English translation "Electric Waves." I can think of no scientific article which illustrates so well not only what research in experimental physics ought to be, but also how the results should be presented. It is a good illustration also of the importance of the unexpected things that so frequently turn up in experimental work. It will be remembered that the discovery of the photo-electric effect came as an incident in Hertz's work on electric waves. As difficulty was experienced in seeing the minute sparks that indicated the response of the resonator, he tried to improve matters by placing a box around the gap so as to screen the eyes. But instead of making it easier to see the sparks the box apparently made the resonator less sensitive. I imagine that most of us would have been content to call the attempted improvement a failure, and would have dismissed the matter with mingled feelings of mild wonder that the scheme didn't work, and regret that we had wasted so much time in making the box. But Hertz was not content to simply wonder. He set out to discover why the box had such an unexpected effect, and by a beautifully logical series of experiments and deductions he found the answer to his question. Since it appeared that the new phenomenon had no bearing upon what he regarded as his more important problem, he left its further study to others and returned to the subject of electric waves.

Hertz's paper aroused wide-spread interest and the work was quickly taken up by others. During the first nine years after Hertz's discovery more than one hundred articles dealing with the photo-electric effect were published, and interest in the subject has continued undiminished since. As no résumé of the subject has been published which is at all complete, it is clear that the physicist who wishes to make himself familiar with what has been done in this important field has no small task before him.[1] The almost simultaneous

[1] A résumé of work on the photo-electric effect was published in SCIENCE, Vol. IV., p. 853 and p. 890, 1896, which was, I believe, complete to the time of publication. The subject has developed so greatly since that time, however, that this summary has little more than historical interest.

appearance of two books on the subject of photo-electricity is a welcome response to a very general demand.

Dr. Allen's book is intermediate in character between a popular or semipopular presentation—such as would be suitable for the reader with a general scientific interest, or for workers in subjects related to physics—and a detailed summary intended for the specialist. After two introductory chapters, giving a very brief general survey of the whole field and an account of the work of the early experimenters, the author takes up in greater detail such subjects as the emission of electrons in a vacuum, the velocity of the electrons emitted, the photo-electric behavior of different substances, the influence on photo-electric phenomena of gas-pressure, temperature and the wave-length of the exciting light, and photo-electric fatigue, to whose experimental study Dr. Allen has himself contributed. Then follow chapters on "Theories of Photo-electric Action," "Fluorescence and Phosphorescence," and "Photo-electrical Actions and Photography." Since the topics treated in the last two chapters, although probably related to the subject of photo-electricity, are not to be regarded as essential parts of the general subject, the author makes no attempt at a complete treatment of these topics.

Dr. Allen makes no attempt to summarize all the articles dealing with photo-electricity, and has not given a complete bibliography. The value of the book would have been greatly increased if a complete list of articles had been given. But even without this the book is of great value. In discussing each topic references are given to some of the more important original articles, so that the reader who wishes to go into the subject in detail will be greatly helped.

For the specialist I imagine that Dr. Hughes's book will be found the more useful of the two. It assumes considerable familiarity on the part of the reader with the subject and with related subjects, and goes into greater detail in the critical discussion of the results obtained by different observers. This is especially true in the case of those phases of the subject which are now attracting most attention. At the end of each chapter there is a summary of results, and in many cases a discussion of their theoretical bearing, which will be found very useful. References to original sources, although not complete, include most of the more important articles. In the main the ground covered is the same for the two books. Dr. Hughes includes, however, a chapter on the ionization of gases by ultra-violet light, which is looked upon as one instance of photo-electric action. There are also short chapters on positive rays produced by light, and on the sources of light used in photo-electric experiments. On the other hand the treatment of photo-electric fatigue is less complete than in Dr. Allen's book, and the subjects of luminescence and of photographic action, to which Dr. Allen devotes two chapters, are not taken up at all.

In discussing the velocity of emission of photo-electrons Dr. Hughes points out that while it seems probable that a linear relation exists between the maximum energy of the photo-electrons and the frequency of the exciting light, so that the retarding potential necessary to prevent discharge is given by $V = kn - V_0$, the constant k has not been found to have the value h/e which Einstein's theory, based on the theory of quanta, would lead us to expect. Since this chapter was written Millikan's measurements on sodium have not only established the linear relation between V and n with greater exactness and through a wider range than has been done by any previous investigation but have also led to a value of ke which differs from h by considerably less than the uncertainties in the value of Planck's constant. This chapter of Hughes's book would undoubtedly have been considerably modified if it had been written after the publication of Millikan's work. Nevertheless the author's discussion retains its value, for the results obtained by other observers still requires explanation.

I am convinced that these books will be found most useful, both by those who wish only to be informed regarding recent progress in the subject of photo-electricity and by those who are engaged in investigation in this field.

ERNEST MERRITT